Where PG 76-22 is being used in the production of ultra-thin, the grade of asphalt binder to be paid will be PG 70-28, unless otherwise approved.

The above prices and payments will be full compensation for all work covered by this section including, but not limited to, furnishing all materials, producing, weighing, transporting, placing and compacting the polymer modified asphalt emulsion; maintaining the ultra-thin bonded wearing course until final acceptance of the project; performing QC as specified in the contract; and making any repairs or corrections to the surface of the pavement or adjacent landscape that may become necessary.

Payment will be made under:

Pay Item	Pay Unit
Ultra-thin Bonded Wearing Course, UBWC	Ton
Application of Ultrathin Hot Mix Asphalt	Square Yard

SECTION 663
HOT IN-PLACE RECYCLED ASPHALT CONCRETE

663-1 DESCRIPTION

This work shall consist of hot in-place recycling of the existing asphalt concrete surface by heating and softening the existing asphalt pavement with indirect heat, loosening the heated pavement by hot milling to the depth specified in the plans, adding a plant produced hot mix asphalt admixture, if required, applying a rejuvenating agent, thoroughly remixing the material in a pugmill, leveling, relaying and compaction of the hot in-place recycled asphalt mixture. Use a continuous, single train, single pass, multi-step process to accomplish this work.

Provide and conduct the QC and required testing for acceptance of the hot in-place recycled mixture in accordance with the contract.

663-2 MATERIALS

(A) Hot Mix Asphalt Admixture

Determine the type and amount of plant produced hot mix asphalt (HMA) admixture to be added to the recycled mixture, subject to the approval of the Engineer. The HMA admixture shall be a plant mixture of asphalt binder and aggregate(s) meeting Division 10 as shown below. The aggregate in the admixture may be a single standard size aggregate or a combination of aggregate sizes as needed. Provide enough binder content for the admixture such that the aggregate particles are fully coated. Provide a gradation and binder content for the admixture such that when blended with the other mix components, the hot in-place recycled mix properties shall meet the mix design criteria for the applicable mix type specified in the plans, unless otherwise approved by the Engineer.

Refer to Division 10.

Item	Section
Anti-strip Additives	1012-1(G)
Asphalt Binder	1020-2
Coarse Aggregate	1012-1(B)
Fine Aggregate	1012-1(C)

(B) Asphalt Rejuvenating Agent

Use an asphalt rejuvenating agent in accordance with Table 663-1.

TABLE 663-1
ASPHALT REJUVENATING AGENT PROPERTIES

Property	Minimum	Maximum
Viscosity, 77°F, SFS, ASTM D244	20 SFS	125 SFS
Sieve, %, ASTM D244	-	0.10%
Storage Stability, 24 hr, %, ASTM D244	-	1%
Residue from distillation, %[A]	60%	-
Oil Distillate, Volume %	-	5
Tests on Residue and Rolling Thin-Film Oven Tests:[B]		
Penetration @ 77°F, 5 sec.	300	-
Torsional Recovery 39.7°F, %	20%	-

A. ASTM D244 except that the maximum temperature shall be 350°F held for 20 minutes.

B. The residue from distillation shall be subject to the standard rolling thin film oven test.

663-3 COMPOSITION OF MIXTURE

(A) General Mix Design

Prepare and submit a proposed hot in-place recycled mix design and JMF to the Engineer at least 20 days before beginning work in accordance with Article 610-3 except as modified herein. Submit a proposed mix design for the admixture if an admixture is required.

Sample the existing pavement by coring, or other methods approved by the Engineer, to determine representative characteristics and properties of the existing pavement for use in mix design preparation. Take at least one sample every 2,000 lf of each lane. Provide samples for QA testing when requested by the Engineer. Take all QA test samples in the presence of the Engineer and at locations approved by the Engineer.

Perform and document a mix design in accordance with the Department's policies and procedures. Contact the Asphalt Design Engineer at the Materials and Tests Unit for copies of these procedures, if needed. Establish the proposed hot in-place recycled mix design such that the hot in-place recycled mix properties are within the design criteria for the type mix specified, unless otherwise approved by the Engineer. Submit the mix designs on forms and in the format approved by the Department. Once the proposed mix designs are approved, the Engineer will provide approved JMFs.

In addition to applicable mix design data required in Subarticle 610-3(A), the data shall include, but not be limited to, the proposed percent admixture, if needed, admixture components, gradation, binder grade, binder content, percent anti-strip additive in admixture, percent existing pavement (RAP), gradation and binder content of existing pavement, percent rejuvenating agent, penetration of recovered binder from total mix and all mix design properties and calculations.

(B) Mix Design Criteria

The finished asphalt pavement shall be a uniform mixture composed of the existing in-place asphalt pavement, asphalt rejuvenating agent and new hot mix asphalt admixture, if required. The hot in-place recycled asphalt mix shall meet Article 610-3 for the mix type specified, excluding the maximum percentage of allowable RAP and as modified herein.

The proposed hot in-place recycled mix design shall be established such that the hot in-place recycled mix properties will meet applicable gradation and mix design requirements of Table 610-2 and Table 610-3 for the mix type specified, except as modified herein, unless otherwise approved by the Engineer.

Add an asphalt rejuvenating agent at a rate that yields a completed mixture with the penetration value as specified in Table 663-1, unless otherwise approved by the Engineer.

(C) Job Mix Formula (JMF)

If the proposed mix design is approved, the Engineer will provide a JMF for the hot in-place recycled asphalt mix. The JMF will be established within the design criteria in Tables 610-2 and 610-3, unless otherwise approved by the Engineer.

If the hot in-place recycled mix design is approved, the Engineer will provide a JMF for the admixture if admixture is required. Produce the completed admixture in accordance with the JMF requirements for gradation and binder content in the contract.

Samples of the completed recycled mixture may be taken by the Department on a random basis to determine if the PG grading on the recovered asphalt binder is in accordance with AASHTO M 320 for the grade specified. If the grading is determined to be a value other than required for the specified mix type, the Engineer may require the Contractor to adjust the grade and the percentage of additional asphalt binder, asphalt rejuvenator and the blend of reclaimed material and admixture to bring the PG grade to the specified value for the required mix type in accordance with Table 610-3.

663-4 EQUIPMENT

(A) General

Equipment used to recycle the existing asphalt surface shall be designed and built for this specific purpose. The equipment shall be capable of a single pass, multi-step operation that includes multi-step heating, milling, introducing rejuvenating agent, introducing hot mix asphalt admixture, if required, mixing the new material with the reclaimed material in a separate on-board chamber, redistributing the recycled material, leveling and compacting the mixture.

(B) Pre-heating Units

Supply pavement pre-heaters capable of uniformly heating the asphalt pavement to a temperature high enough to remove excess moisture, to allow milling of the existing pavement material to the designated plan depth without excessive fracturing of aggregate particles, without charring the existing asphalt and without producing undesirable pollutants. Equip the heating mechanism so that the heat application is completely under an enclosed or shielded hood. Protect adjacent landscape from heat damage and repair any damage that may occur. The unit shall be adjustable in width. Ensure that the heaters overlap the completed adjacent lane by at least 6" to create a hot bond at the longitudinal joint.

(C) Milling/Blending Unit

Supply a self-propelled processing unit containing the following:

(1) A recycling machine equipped with additional heaters conforming to the same requirements as the pre-heaters.

(2) A unit capable of uniformly loosening the existing asphalt pavement to the depth specified. Care shall be taken to ensure that milling or pavement reclaiming does not degrade the aggregates but only loosens the heated existing pavement.

(3) A controlled system for adding and uniformly blending a rejuvenating agent at a predetermined rate with the reclaimed mix during the remixing and leveling operation. The metering equipment shall be capable of measuring in gallons. The application rate in gallons, for the added material, shall be synchronized with the machine ground speed to provide a uniform application. The actual rate used may be adjusted as determined.

(4) A blending unit consisting of a twin shafted pugmill capable of uniformly adding new hot mix asphalt admixture, if required, at a rate established by the mix design. The unit shall be capable of thoroughly mixing the loosened asphalt pavement, asphalt rejuvenating agent and new hot mix asphalt admixture, if required, at the pugmill to produce a uniform mixture.

(5) A unit capable of auguring the heated and loosened material into a windrow at the center of the machine before entry into the blending unit.

(6) A paving machine meeting Article 610-8, except as modified herein, shall be used to redistribute the remixed material over the width being processed and finished to produce a uniform cross section and surface. The paving machine shall be capable of screeding the full width of the remixed material. Provide and use automatic screed controls in accordance with Subarticle 661-4(A), unless otherwise approved by the Engineer.

(7) The recycling train shall be capable of maintaining an average production rate of at least one lane mile per day.

(8) The reheating and remixing units shall meet all State and local air quality emission standards for mobile sources.

(D) Compaction Equipment

Use rollers meeting Article 610-9 and capable of achieving the specified density and surface requirements.

663-5 CONSTRUCTION METHODS

Hot in-place recycled mixtures shall not be produced or placed during rainy weather or when the air temperature measured in the shade away from artificial heat at the location of the paving operations is less than 50°F. Do not place surface course material that is to be the final layer of pavement between December 15 and March 16 of the next year.

Before heating and remixing operations, the pavement shall be cleaned of all loose material. Power brooms shall be used and supplemented when necessary by hand brooming or other cleaning operations, as required, to bring the surface to a clean, suitable condition free of deleterious material.

The pavement surface shall be evenly heated, loosened and remixed to the lines, grades and depths shown on the plans. Heating shall be controlled to ensure uniform heat penetration without overheating, cooking or sooting of the asphalt pavement. The milled material shall be picked up, mixed with an asphalt rejuvenator and asphalt admixture, if needed, in a pugmill and then distributed and leveled by a conventional paving machine. The temperature of the milled material shall not be more than 325°F when measured immediately behind the milling unit. The temperature of the remixed material shall not be less than 235°F directly behind the screed.

The heating operation shall extend at least 4" beyond the width of remixing on both sides. When a pass is made adjacent to a previously placed mat, the longitudinal joint shall extend at least 2" into the previously placed mat.

The layer thickness of the hot in-place recycled specified in the Plans or Contract Proposal shall be the compacted in-place thickness of the rejuvenated recycled mixture layer including any admixture. The depth of milling of the existing surface shall be such that the depth as specified on the plans is within ± 1/4", unless otherwise approved by the Engineer.

The asphalt rejuvenator shall be applied uniformly to the mixed material before remixing in the pugmill. The rate of application of rejuvenator will be as specified on the JMF approved by the Engineer based upon the Contractor's proposed mix design.

The remixed asphalt pavement shall be compacted immediately after it has been spread and leveled, while it is still in a workable condition.

Density control may be by either core samples or nuclear density control in accordance with the Department's procedures. Density for hot in-place recycled mixes shall meet Table 610-6 for the specified mix type. The maximum specific gravity tested in accordance with AASHTO T 209 will be determined by procedures specified in the Department's *HMA/QMS Manual*.

The compacted surface of the completed and accepted pavement structure shall meet Article 610-12.

The Contractor shall take precautions needed to protect the adjacent landscape from heat damage. Damaged landscape shall be repaired or replaced.

663-6 MEASUREMENT AND PAYMENT

Hot In-Place Recycled Asphalt Concrete, Type ____ will be measured and paid by the square yard in the completed and accepted work.

Emulsified Asphalt Rejuvenating Agent to be paid will be measured by the metered quantity in gallons used in all completed and accepted work and will be paid at the contract price per gallon.

Hot Mix Asphalt Admixture, when required, will be measured by being weighed in trucks on a certified weighing device and documented on load tickets and will be paid at the contract unit price per ton.

Asphalt binder in accepted work will be measured and paid in accordance with Section 620.

The above prices and payments will be full compensation for all work covered by this section including, but not limited to, furnishing all materials, producing, weighing, transporting, placing and compacting the recycled pavement; maintaining the finished course until final acceptance of the project; performing QC as specified in the contract; and making any repairs or corrections to the surface of the pavement or adjacent landscape that may become necessary.

Payment will be made under:

Pay Item	**Pay Unit**
Hot In-Place Recycled Asphalt Concrete, Type ____	Square Yard
Emulsified Asphalt Rejuvenating Agent	Gallon
Hot Mix Asphalt Admixture	Ton